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The Deletion of *w* in Seoul Korean and its Implications*

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1. Introduction

In Korean, the labiovelar *w* is often observed to delete in speech (e.g., /cuk'wən/ —> [cuk'ən] 'sovereignty', /pwa/ -> [pa] 'look!', /sakwa/ —> [saga][1] 'apple'). This process has been discussed by some scholars. For instance, P. K. Lee and K. R. Park (1992:19) observe that the deletion of *w* occurs frequently after bilabial consonants and suggest that *w* deletion is a dissimilatory process to avoid successive labiality. Martin (1992) also makes noteworthy observations. He (1992:36) notes, "the phoneme *w* freely drops after *p, ph, ps, m, wu* ([u]), or *o* ... in sloppy speech (and widely in Seoul) *w* often disappears after nonlabial sounds, too...". Martin's remarks indicate that he is keenly aware that *w* deletion is a variable process and that it occurs more often in certain phonological contexts.

These scholars' observations are, though insightful, impressionistic. The pioneering study of *w* deletion based on real speech data was that of Silva (1991). He suggests that *w* deletion is conditioned by such linguistic factors as the articulation point and phonation manner of the preceding consonant and also by the frontness/backness of the following vowel. He also suggests that *w* deletion is sensitive to such external factors as speech style and the social status of the speaker. His study clearly shows that the deletion of *w* is a sociolinguistic process conditioned both by linguistic and external factors. In addition, Silva (1991) attempts to explain the deletion of *w* in terms of phonological theory using notions of feature geometry and the Obligatory Contour Principle.

Silva's study, however, has two problematic points. One is his assumption that *w* deletion occurs only after a preceding consonant, while the fact is that *w* deletion can occur with or without a preceding consonant (Martin 1992, K. W. Nam 1984). The other point is that his study is based solely on read speech, which can be considerably different from

[1] Korean has a voicing rule that changes voiceless lax plosives into their voiced counterparts between voiced segments.

spontaneous speech or from vernacular speech (Labov 1972), where the most interesting patterns of variation are believed to be found.[2]

Tackling these two problematic points in Silva's study, the current study reexamines the variable deletion of *w* on the basis of a larger database. The examination of my data produces somewhat different results from those of Silva's (1991). Especially, unlike Silva's study, the current research finds that bilabial and nonbilabial consonants preceding *w* show dichotic behavior in their effects on *w* deletion, i.e., *w* is found to delete significantly more often after bilabial consonants than after the other types of consonants. To account for these results, I present explanations along a different line from that of Silva. I will suggest that the finding that *w* deletion occurs predominantly after bilabial consonants can be explained by the notion of the Obligatory Contour Principle as a rule trigger (Yip 1988).[3] I will also show that the loss of *w* that has occurred in many lexical items of Korean containing the 'labial consonant + *w*' sequence is one of those perception-based changes that Ohala (1981:187) calls "sound change by the listener".

The organization of this paper is as follows. In Section 2, I will provide some background information on *w* deletion in Seoul Korean for the readers. I will discuss the data and explain the methods used for the analysis of the data in Section 3. The results of the statistical analyses will be given in Section 4, and their implications will be discussed in Section 5. I will attempt to provide phonological explanations of the synchronic deletion of *w* and phonetic explanations of the diachronic loss of *w* in Section 6, followed by concluding remarks in Section 7.

2. Background

In this section, I will discuss some basic concepts in Seoul Korean phonology that will be essential to understand the methods and results of the present study. The syllable structure of Seoul Korean can be schematized as Figure 1. The minimal syllable is V with three optional elements: an onset, a glide and a coda. The internal structure of the Seoul Korean syllable is not without controversy. Following Sohn (1987) and H. Y. Kim (1990), I will assume that GV sequences in Seoul Korean are rising diphthongs.

$$\begin{array}{c}\sigma \\ \text{(C)(G)V(C)}\end{array}$$

Figure 1. Syllable structure of Seoul Korean

Following Kim-Renaud (1974) and K. R. Park (1992), I also assume that contemporary Seoul Korean has the monophthongs in Table 1. That is, I assume that vowels *ü* and *ø* have changed to diphthongs *wi* and *we* in Seoul Korean and that they are no longer monophthongs of this dialect. The present study also assumes (following Hong 1988 and H. B. Lee 1971) that the vowels *e* and *ε* have (near-)merged to *e*. Table 2 gives the current system of *w* diphthongs in Seoul Korean. The *w* diphthongs are all rising (C. S. Lee 1994, Martin 1992). One thing to note is that *w* cannot be combined with round vowels. In other words, *w* cannot form a diphthong combined with [labial] vowels.

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[2]See Macaulay and Trevelyan (1973) for the discussion of the differences between read and spontaneous speech in this respect.

[3]As noted earlier, Silva (1991) also tries to explain the variable patterns of *w* deletion using the notion of the OCP. However, his explanation of *w* deletion relies on the notion of multiple linking (of the [+back] feature) caused by the OCP rather than the rule triggering effect of the OCP.

Table 1. Monophthongs of Seoul Korean

[-bk]	[+bk]	
i	ɨ	u
e	ə	o
(ɛ)	a	

Table 2. *w* Diphthongs of Seoul Korean

[-bk]	[+bk]	
wi	*wɨ	*wu
we	wə	*wo
(wɛ)	wa	

The current consonant system of Seoul Korean is given in Table 3. Table 3 shows that Korean plosives have a three way distinction in phonation type, i.e., lax, reinforced and aspirated. As Figure 1 suggests, consonants can precede and combine with *w* diphthongs, though not all logical possibilities are actually implemented. When a consonant precedes *w* diphthongs, there are cases where a morpheme boundary is present between the consonant and *w* (e.g., /sam+wəl/ 'March (three+month)', /man+wən/ 'full house (full+people)') and cases where a morpheme boundary is not present between the two (e.g., /kyo+hwan/ 'exchange (inter+exchange)', /so+nwe/ 'cerebellum (little+brain)'). *w* can occur after a vowel (e.g., /sawəl/ 'April', /kuwən/ 'salvation') and also at the word-initial position (e.g., /wicaŋ/ 'stomach', /wənin/ 'reason').

Table 3. Consonants of Seoul Korean

	bilabial	alveolar	palatal	velar	glottal
stop	p, p', p^h	t, t', t^h		k, k', k^h	
affricate			c, c', c^h		
fricative		s, s'			h
nasal	m	n		ŋ	
liquid		l			

In addition to underlying /w/, *w* can also arise derivationally through /glide formation/ (*o* —> *w* / _____ + V (e.g., /no+a/ —> [nwa] 'release!', /s'o+a/ —> [s'wa] 'shoot!')) and /vowel contraction/ (*u* —> *w* / C _____ V, e.g., /cuəssta/ —> [cwətt'a][4] '(I) gave', /muəs/ —> [mwət] 'what' (cf. Eom T. S. 1993)). Underlying *w* and derivational *w* do not show different behavior with respect to *w* deletion.

3. Methods

3.1. Data

The data were collected during the author's stay in Seoul, Korea in the summer of 1994 and the winter to early Spring of 1995. Approximately 30 minutes of recordings were made from 77 speakers. The speakers were stratified by age, social status and sex. There were 2 gender groups, 3 age groups, 3 social status groups, making 18 cell groups.

[4]Korean has a rule that simplifies the syllable-final consonant cluster, a coda neutralization rule that neutralizes obstruents to lenis voiceless stops at the coda position, and an obstruent tensing rule that fortifies a lax obstuent to its tense counterpart after an obstruent.

Four different styles of speech were elicited — two styles of spontaneous speech: interview speech and in-group speech; and two styles of read speech: sentence reading and word-list reading. The data used for the present study come from the recordings of four different styles of speech from 71 speakers (six speakers were found not to be native speakers of Seoul Korean, so their speech data were not used for analysis). Interview and ingroup speech were elicited from 54 speakers and from 35 speakers, respectively (eighteen speakers overlap).

For the analysis of spontaneous speech, recordings of interview speech and ingroup speech were used. The tokens which appear in the last 20 minutes of the recording were selected as the tokens for this study. On average, approximately 20 to 30 tokens were found for the interview speech of each speaker in this portion of the recording, and 10 to 20 tokens were found for the ingroup speech.[5] The sentences and words chosen for sentence list and word list readings were also designed to contain many tokens of *w* deletion. The sentence list and the word list contained 52 and 43 potential tokens of the variable (w), respectively. These potential tokens were designed to reveal the effects of various constraints on *w* deletion that will be discussed in the following subsection. Speakers sometimes misread potential tokens. These cases were not taken as tokens of (w).

The judgment regarding the presence or the absence of the glide was made at the time of transcription and rechecked later. Each token was judged {w}, {ø} or 'ambiguous'. Ambiguous cases accounted for approximately 7 percent (N = 601) of the tokens (N = 8603). These tokens were excluded from analysis. One hundred tokens were selected from each of the three groups of tokens, i.e., from each group of the tokens identified by the researcher as {w}, {ø} and 'ambiguous'. Another Seoul Korean speaker checked these tokens independently. Her judgment and mine showed 88, 87 and 78 percent of agreement in the {w} group, in the {ø} group and in the 'ambiguous' group, respectively. This study is based on 8002 tokens of the variable (w) from 71 speakers' data containing both spontaneous (ingroup + interview) and read speech.

3.2. Variable rule analysis

Silva (1991) formulates the following basic rule of *w* deletion.

(1) *w* —> ø / C ____ V

However, as Martin (1992) and K. W. Nam (1984) suggest, *w* deletion is not confined to this environment. *w* deletion can occur even when a preceding consonant is not present, e.g., /howi/ —> [hoi] 'defense', /kiwa/ —> [kia] 'roof tile', /suwən/ —> [suən] 'origin of a stream'. Accordingly, I suggest that rule (2) is a more correct representation of the environments where this process occurs.

(2) *w* —> ø / (C) ____ V

The specific environments where *w* deletion occurs are more explicitly shown by (3) and (4).

(3) *w* —> ø / C ____ V

[5] The number of tokens in the recording of ingroup speech was partly dependent on those who were present as participating members. For instance, if the members who took part in the dialogue interaction belonged to the same social group (i.e., same sex, social status and age group), the number of the tokens for that particular group increased, because it was possible to include the tokens of *w* from all participants.

(4) $w \longrightarrow \emptyset$ / {V, #} ____ V

That is, *w* can delete between a consonant and a vowel, between two vowels, and word-initially before a vowel. The deletion of *w* is very sensitive to whether there is a preceding consonant. According to the analysis of my data, *w* is deleted approximately 5% (83/1752) when there is no preceding consonant and 26% (1634/6250) when there is one (cf. Tables 7 and 8 in Section 4).

Furthermore, (3) and (4) are affected by somewhat different constraints. Silva (1991) suggests that (3) is affected by the place of articulation and the phonation type of the preceding consonant. A morpheme boundary between the preceding consonant and *w* can also be a factor in (3). On the other hand, Martin (1992) and K. W. Nam (1984) suggest that the deletion of *w* after a vowel is sensitive to whether the preceding vowel is round or not.

Because of these two reasons, i.e., because (3) and (4) have a significant difference in deletion rate and are sensitive to partly different constraints, two separate Goldvarb (Goldvarb 2.1. Rand and Sankoff 1992) analyses were performed. The number of the tokens for *w* deletion after a consonant was 6250 and *w* deletion without a preceding consonant had 1752 tokens.

3.2.1. Factor groups considered for the Goldvarb analysis of the deletion of *w* with a preceding consonant

Silva (1991) examines the factor groups listed in Table 4 in his Varbrul analysis. All the linguistic factor groups considered in Silva's study were also included in my analysis of *w* deletion with a preceding consonant. However, slight modifications were made. First, in my analysis, five different factors were included under the factor group 'preceding consonant (place)'. In addition to labial, alveolar, palatal and velar places, the glottis was also included as a place for the analysis of the *h* + *w* sequence. Secondly, though the presence of the morpheme boundary between the preceding consonant and *w* was included as a factor group, only two factors, i.e., ø/present, were coded. The reason that I did not divide morpheme boundary into Sino-Korean morpheme boundary and native Korean morpheme boundary was that few tokens (only 8 among 6250 tokens) in my data had a native Korean morpheme boundary. As in Silva's study, the factor group 'preceding consonant ((phonation) manner)' (i.e., whether the preceding consonant is lax, aspirated or reinforced) was considered only for the plosives, and the factor group 'following vowel' was divided into [-back] and [+back] vowels.

Table 4. Factor groups considered in Silva (1991:159)

Factor groups	Factors
*1. preceding consonant, place	labial, alveolar, palatal, dorsal
*2. preceding consonant, manner	lax, aspirated, reinforced
*3. following vowel	front, nonfront
4. morpheme boundary preceding *w*	none, Sino-Korean, native
*5. speech style	minimal pairs, word list, sentences, text
6. age	teen, adult
*7. gender	female, male
8. education level	high school or less, college
9. hometown	Seoul area, other
*10. Father's occupational prestige	higher, lower

*The starred factor groups mark those chosen in the stepwise regression analysis.

Two additional linguistic factor groups were included in my analysis. The first concerns whether *w* occurs in the initial or a noninitial syllable of the word. The distinction between initial vs. noninitial syllable has played an important role both in diachronic phonological changes and synchronic variation in Seoul Korean. The sound change of /ʌ/ to /a/ and /ɨ/, which happened during the Middle Korean period, is one example. The now lost vowel /ʌ/ changed, in most cases, to /a/ in the initial syllable of the word and to /ɨ/ in a noninitial syllable, e.g., /pʰʌɾi/ > /pʰaɾi/ 'fly' but /namʌɾata/ > /namɨɾata/[6] 'reprimand'. The change from /o/ to /u/, which began early in the 16th century, occurred mostly in a noninitial syllable of the word, e.g., /kocʰo/ > /kocʰu/ 'hot pepper', /namo/ > /namu/ 'tree'. Tensification of obstruents, an ongoing change in Seoul Korean, occurs mostly in the initial syllable, e.g., /kwa+samusil/ —> [k'wa+samusil] 'department office', /tarɨn/ —> [t'arin] 'other'. The realization of the diphthong /ɨy/ as [ɨy] occurs considerably more often in the initial syllable than a noninitial syllable, e.g., /ɨysa/ —> [ɨysa] 'doctor' vs. /yuɨy/ —> [yui] 'attention'. The deletion of *y* before the vowel /e/ is more frequent in the noninitial syllable than in the initial syllable, e.g., /yesul/ —> [yesul] 'art' vs. /toye/ —> [toe] 'ceramic art'. Because of phonological similarities of *w* deletion to *y* deletion and because of my impression that *w* deletion is another process sensitive to the syllable position within the word, I included this factor group in the Goldvarb analysis.

The other linguistic factor group added in the Goldvarb analysis is the presence of the coda consonant in the syllable where *w* appears. Current phonological theories (e.g., Prince and Smolensky 1993, McCarthy and Prince 1995, Rosenthall 1994) suggest that both codas and diphthongs make syllable structure more marked. Syllable structure CGVC is believed to be less natural than CGV, since the former has two marked features (coda and diphthong), while the latter has only one (diphthong). One possibility worth checking is whether *w* deletion occurs more frequently in a more marked structure (CGVC) than in a less marked structure (CGV), i.e., whether markedness in the coda position affects markedness in the syllable nucleus.

Four potential external constraints, 'speech style', 'gender', 'social status' and 'age', were also considered in my analysis. Table 5 lists the factor groups (and their factors) examined in the Goldvarb analysis of the deletion of *w* without a preceding consonant. Since the number of the tokens (N = 6250) was large enough to allow Varbrul analyses on subsets of tokens, the tokens of three different styles of speech (spontaneous, sentence reading, word-list reading) were also subject to separate Varbrul analyses. The results are given in the Appendix I for reference.

Table 5. Factor groups considered in the variable rule analysis of the deletion of *w* with a preceding consonant

Factor groups	Factors
1. preceding consonant, place	labial, alveolar, palatal, velar, glottal
2. preceding consonant, manner	lax, aspirated, reinforced
3. following vowel	[-back], [+back]
4. syllable type	initial, non-initial
5. morpheme boundary preceding *w*	ø, present
6. presence of the coda	ø, present
7. speech style	ingroup, interview, sentence reading, word-list reading
8. gender	female, male
9. social status	upper, middle, lower
10. age	16-25, 26-45, 45 and older

[6]/namɨɾata/ later changes to /namurata/ through vowel labialization.

3.2.2. Factor groups considered for the Goldvarb analysis of the deletion of *w* without a preceding consonant

The Varbrul analysis of *w* deletion without a preceding consonant considered the factor groups given in Table 6. Three factor groups, 'preceding consonant (place)', 'preceding consonant (manner)' and 'morpheme boundary between *w* and the preceding consonant', were naturally excluded in this analysis. However, following the suggestions of Martin (1992) and K. W. Nam (1984) that *w* is more apt to delete after a round vowel, the round/nonround vowel parameter was added as another factor group. This factor group was considered only for those tokens where *w* occurs after a vowel.

Table 6. Factor groups considered in the variable rule analysis of the deletion of *w* without a preceding consonant

Factor groups	Factors
1. following vowel	[-back], [+back]
2. syllable type	initial, noninitial
3. presence of the coda consonant	ø, present
4. preceding vowel	round, nonround
5. speech style	ingroup, interview, sentence reading, word-list reading
6. gender	male, female
7. social status	upper, middle, lower
8. age	16-25, 26-45, 45 and older

4. Results

The results of the Goldvarb analysis of *w* deletion after a consonant are given in Table 7. Those factor groups that show a difference in weight bigger than 0.1 between the two most distinct factors and thus show a relatively clear difference among the factors were factor groups 'preceding consonant (place)', 'style', 'syllable type', 'social status', and 'age'. These factor groups were all chosen in the stepwise regression analysis. Though the factor groups 'preceding consonant (manner)', 'following vowel', 'presence of the coda' and 'gender' were also selected in the same analysis, they showed only minor probability differences (smaller than 0.1) among their factors. The reason that these factor groups were selected in the stepwise regression analysis is probably attributable to the large number of the tokens (N = 6250), since a large sample size can make a small amount of difference in probability statistically significant — i.e., a larger sample size increases the power of significance tests (Hays 1988, Popham and Sirotnik 1992). The detailed results of the stepwise regression analysis are given in (5).

(5) Groups chosen in the stepwise analysis and the order of selection[7]

1. preceding consonant (place)
2. speech style
3. syllable type
4. social status
5. preceding consonant (manner)
6. age
7. presence of the coda consonant
8. following vowel
9. gender

[7]The order of selection in the step-up analysis and the order of elimination in the step-down analysis were exactly the opposite (mirror images) in this analysis.

Table 7. Goldvarb probabilities for factors for *w* deletion after a consonant

Factor groups	Factors	Weight	% Applications	Total N
*Preceding C (place)	bilabial	0.955	81	886
	alveolar	0.454	23	1860
	palatal	0.298	11	836
	velar	0.354	16	1774
	glottal	0.346	12	894
*Preceding C (manner)	lax	0.509	30	2718
	aspirated	0.475	14	600
	reinforced	0.488	19	810
*Following vowel	[-bk]	0.531	22	3205
	[+bk]	0.468	31	3045
*Syllable type	initial	0.421	24	3721
	noninitial	0.615	29	2529
Morph. boundary	zero	0.504	25	5661
	present	0.459	38	589
*Presence of coda	zero	0.522	26	4049
	present	0.459	27	2201
*Speech Style	in-group	0.667	39	850
	interview	0.631	30	1421
	sentence R	0.427	22	2230
	word list R	0.402	21	1749
*Gender	male	0.476	24	3188
	female	0.525	28	3062
*Social Status	upper	0.414	22	2103
	middle	0.498	25	2087
	lower	0.590	32	2060
*Age	16-25	0.545	30	2111
	26-45	0.524	27	2099
	46+	0.429	21	2040

number of cells: 2585 total chi-square = 3004.0572
chi-square/cell = 1.1621 loglikelihood = – 2654.210 Input = 0.235
overall deletion rate = 26.1%

The results of the Goldvarb analysis of *w* deletion without a preceding consonant are somewhat different from those of the previous analysis. These results are given in Table 8. Five factor groups show a relatively clear weight difference (bigger than 0.1) between the most favorable factor to *w* deletion and the least favorable. These are factor groups 'syllable type', 'preceding vowel', 'social status', 'age', and 'style'. However, the factor group 'style' was not chosen in the step-up analysis, though it was eliminated last in the step-down analysis. The detailed results of the stepwise regression analysis are given in (6).

Table 8. Goldvarb probabilities for factors for the deletion of *w* without a preceding consonant

Factor groups	Factors	Weight	% Applications	Total N
Following vowel	[-bk]	0.504	4	657
	[+bk]	0.497	5	1095
*Syllable type	initial	0.303	1	1090
	noninitial	0.797	10	662
Presence of coda	zero	0.520	5	861
	present	0.480	4	891
*Preceding vowel	[+rnd]	0.738	19	200
	[-rnd]	0.389	6	462
Speech Style	in-group	0.578	5	277
	interview	0.549	5	465
	sentence R	0.477	4	501
	word list R	0.436	5	509
Gender	male	0.524	5	869
	female	0.476	4	883
*Social Status	upper	0.385	3	584
	middle	0.501	4	585
	lower	0.614	7	583
*Age	16-25	0.608	7	601
	26-45	0.486	4	553
	46+	0.404	3	598

number of cells: 523 total chi-square = 516.0708
chi-square/cell = 0.9868 loglikelihood = – 272.459 Input = 0.022
overall deletion rate = 4.7%

(6) Results of the stepwise regression analysis

A. factor groups selected in the step-up analysis and the order of selection

1. syllable type
2. preceding vowel
3. social status
4. age

B. groups eliminated in the step-down analysis and the order of elimination

1. following vowel
2. presence of the coda consonant
3. gender
4. style

5. Discussion

The results of the two Goldvarb analyses suggest that the articulation point of the preceding consonant, the roundness of the preceding vowel and syllable type are the important linguistic constraints conditioning the deletion of *w* in Seoul Korean. Though factor groups 'preceding consonant (manner)', 'following vowel (backness)' and 'presence of the coda' were selected in one of the two stepwise regression analyses, the minor differences in Goldvarb weight among the factors do not provide support to the interpretation that the effects of these constraints are strong in the variability of *w* deletion. Especially the fact that the 'ø' coda factor had higher probability of *w* deletion than the 'present' coda factor is not expected and presumed to be a reflection of random variation. The fact that the two gender groups show conflicting results in the two Goldvarb analyses also suggests that the two are not really different in their behavior toward *w* deletion.

As in Silva's (1991) study, the results of the Goldvarb one-level and stepwise-regression analysis of *w* deletion after a consonant identifies the articulation place of the preceding consonant to be the most important constraint. However, in contrast to Silva's research, dorsal consonants and nondorsal consonants do not show a dichotomy in their conditioning of *w* deletion; rather my data indicate that bilabial and nonbilabial consonants show a clearly different behavior toward *w* deletion. These results support previous descriptive statements by Lee and Park (1992) and Martin (1992) suggesting that *w* deletes predominantly after labial consonants. The finding that *w* is deleted significantly more often after a round vowel than after a nonround vowel is consistent with the result that *w* deletes considerably more frequently after labial consonants than after nonlabial consonants, because round vowels and labial consonants are both labial segments.

There are three possible explanations of why *w* deletes in the initial syllable of the word significantly less often than in a noninitial syllable. The first and most convincing one is the explanation given by principles of word processing along the lines of Cutler, Hawkins and Gilligan (1985) and Hall (1992). They suggest that since words are processed from 'left to right', i.e., since lexical access is typically achieved on the basis of the initial part of the word, synchronic and diachronic processes of phonological reduction (weakening, attrition and loss) do not typically take place at the beginning of the words, but in word-medial or word-final position. (For supporting examples of diachronic processes, refer to Chen 1973 and Maran 1971; for examples of synchronic processes, see Clements and Keyser 1983 and Hyman 1975.)

The second possible explanation is given by some Korean phoneticians (e.g., H. Y. Lee 1990, H. B. Lee 1973)[8] who claim that Korean is primarily a language with primary stress on the first syllable of the word. If Korean has stress on the initial syllable and if Korean is primarily a duration accent language, the initial syllable will tend to be lengthened (Klatt 1973, Fry 1955) and the chance of *w* deletion will be significantly lowered. However, the claim that Korean is a stress language has not been rigorously examined. Jun's (1995) recent study, which suggests that stress in Korean usually falls on the second syllable of the accentual phrase (an intonational unit intermediate between prosodic word and intonational phrase), seems to weaken the claim that Korean is primarily a language with stress on the initial syllable of the word.

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[8]H. Y. Lee (1990:51) formulates his Korean stress rule as follows:

1) Two syllable morphemes:
   stress falls on the first syllable.
2) Three or more syllable morphemes:
   If the first syllable is heavy, stress falls on that syllable. Otherwise either on the first or second syllable with no important linguistic difference implied.

Seoul Korean has been known as one of the Korean dialects which has underlying long vowels and uses vowel duration phonemically (e.g., /pa:m/ 'chestnut' vs. /pam/ 'night', /nu:n/ 'snow' vs. /nun/ 'eye'). A third possible explanation for the uneven deletion of *w* in initial vs. noninitial syllables is that this pattern of variation occurs because long vowels occur only in word-initial syllables[9] and long vowels tend not to trigger the deletion of *w*. Though recent studies (e.g., Magen and Blumstein 1993) suggest that long vowels and phonemic length distinction are disappearing even at the word-initial position in Seoul Korean, I examined whether this factor makes any significant difference in the deletion rate of *w* between initial vs. noninitial syllable.

Since there are also claims (C. S. Lee 1994, Jun p.c.) that long vowels appear not at the word-initial syllable but at the initial syllable of the 'prosodic phrase',[10] only the tokens on the word list were used to examine the phonemic vowel duration effect. This decision was made because in word list reading, each word is produced both as one prosodic word and as one prosodic phrase. The New Korean Dictionary (H. S. Lee 1993) was referred to for the underlying long vs. short status of the vowel in the initial syllable of each word. A Goldvarb run incorporating factor group 'vowel length (long vs. short)' to the (slightly modified) existing statistical model[11] was performed on the tokens of word list readings. Only the tokens where *w* appears in the initial syllable were subject to the analysis. The word /hwankak/ 'illusion' or 'return', which according to H. S. Lee (1993) has a long initial vowel when used to mean 'illusion' but a short vowel when used as meaning 'return', was excluded from the analysis because of its ambiguity in vowel length. The results (see Appendix II) did not show a significant difference in the triggering of *w* deletion between phonemically long and short vowels (0.466 vs. 0.543 in probability). The factor group 'vowel length' was not chosen in the stepwise regression analysis either. These results suggest that the initial/noninitial syllable constraint on *w* deletion does not come from the phonemic vowel length difference.

The results that factor groups 'style', 'social status' and 'age' were found to be significant make it clear that *w* deletion is a sociolinguistic process. The conditioning effects of the four factors of the group 'style' show that the deletion rate of *w* decreases as the degree of monitoring one's speech increases. This result shows that the {ø} variant of the (w) variable is not a standard or prestigious variant.

The results show different rates of *w* deletion within both age groups and social status groups. The deletion rate of *w* increases as the social status and age scale go down. The gradual increase in the deletion rate of *w* down the age scale may suggest an ongoing change, since it is probably not the case that older Korean speakers produce speech significantly more carefully than younger speakers. This interpretation gets some support from the existence of other Korean dialects such as Kyongpuk and Kyongnam dialects, where *w* diphthongs have already gone through a monophthongization process. T. Y. Choi (1983) suggests that words containing *w*-diphthongs are gradually losing *w* in Chonpuk dialect at an early stage of monophthongization process. This lexical diffusion type of change may be what is happening in Seoul Korean too. However, since there is no conclusive evidence, the claim that *w* deletion is an ongoing change needs further investigation.

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[9]The underlying long vowel is shortened when it occurs at a noninitial syllable of the word (e.g., /kun+pa:m/ —> [kunbam] 'roasted chestnut', /s'arak+nu:n/ —> [s'aragnun] 'powder(y) snow').

[10]According to this claim, when a speaker produces /i pa:m/ 'this chestnut' as one 'prosodic' phrase (whether the 'prosodic phrase' is an accentual phrase (Jun 1993), phonological phrase (Cho 1990) or rhythmic unit (H. Y. Lee 1990)), it will be pronounced as {i bam}, but when a speaker produces /i pa:m/ 'this chestnut' as two prosodic phrases, it will be pronounced as {i} {pa:m}.

[11]The factor group 'morpheme boundary', which was not chosen as significant in any of the previous analyses, was excluded from the model. Naturally the initial/noninitial syllable parameter was also excluded.

6. Toward explanations

6.1. Phonological explanations

As some previous studies (e.g., Yip 1988, Clements and Keyser 1983, McCarthy 1981) have shown, there are languages (e.g., English, Cantonese, Lami, Akkadian, Yao) which have restrictions on adjacent labial segments. For instance, English does not allow successive labial consonants (*pw, *bw...) at the beginning of the syllable (Clements and Keyser 1983). Cantonese (Yip 1988) has a constraint that prohibits the cooccurrence of labial consonants in the onset and coda positions of the same syllable (e.g., *pim, *ma:p) and also a weaker constraint against the combination of a labial consonant with a round vowel (*tup, *köm). Akkadian allows only one labial consonant per word root (McCarthy 1981). While English does not allow successive labial consonants at the beginning of the syllable, Korean allows them phonemically but rarely does phonetically. This is shown by the fact that Korean speakers delete *w* 85% of the time in spontaneous speech (cf. Appendix I.1.). Korean may have one of the stronger constraints against the combination of *w* with an adjacent labial segment among languages.[12] This claim is supported by the following three pieces of evidence.

First, as was shown in Table 2, *w* can be combined with only 'nonlabial' vowels, which is different from such languages as English (e.g., *would*, *won't*) or Simakonde (one of the languages spoken in Mozambique: e.g., *woe* 'a lot of' or *kuwuula* 'to be sick'). Second, there exist many lexical items in Korean that have lost *w* after labial consonants (e.g., /mweari/ > /meari/ 'echo', /pwe/ > /pe/ 'hemp cloth', /p^hwita/ > /p^hita/ 'blossom'). This process seems to be at the stage of near-completion, since only a few existing words contain an underlying sequence of a bilabial consonant + *w* (cf. C. A. Kim 1978). The third piece of evidence is the clearly different conditioning effects of labial vs. nonlabial vowels on *w* deletion. As shown in Table 8, *w* deletes significantly more often after labial vowels than nonlabial vowels — 19% vs. 6% in percentage (chi-square = 126.02, $p < .01$) and 0.738 vs. 0.389 in probability.

Unlike Silva's study, where dorsal and nondorsal consonants showed dichotic effects in the conditioning of *w* deletion, the present study finds rather that labial and nonlabial consonants show clearly different conditioning on *w* deletion. As shown in Appendix I, read speech and spontaneous speech show no difference in this respect. Silva (1991:165) claims that *w* is deleted less often after a dorsal consonant because the feature [+bk] is multiply linked to a dorsal consonant and *w* in order not to violate the OCP (which he defines as "at the melodic level, adjacent identical elements are prohibited" following McCarthy (1986:208)) and because multiple linking "maintains the integrity of the two segments as a unit" and resists the application of deletion or insertion rules. Silva's (1991) proposal is illustrated in Figure 2.

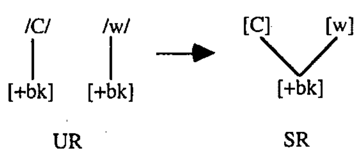

Figure 2. Silva's (1991) proposal

[12] Korean, however, allows the combination of a bilabial consonant and a labial vowel, as shown in the following examples: /mom/ 'body', /mapu/ 'horse-coach driver', /muu/ 'radish'.

I will provide a different line of explanation to account for the clear difference in behavior toward *w* deletion between labial and nonlabial consonants. I suggest that *w* deletion is triggered mainly by OCP effects. In other words, I claim that in Korean *w* deletes predominantly after labial consonants so at to observe the OCP. This is illustrated in Figure (3). The deletion of a segment triggered by the OCP is found in such languages as Seri (Marlet and Stemberger 1983) and Leti (Hume 1995). One important difference between the processes in these languages and *w* deletion in Seoul Korean is that the latter is a variable process.

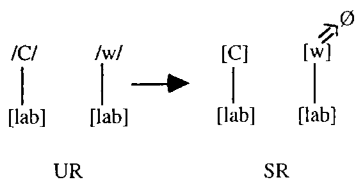

Figure 3. Kang's proposal

The predominant deletion of *w* after a labial consonant can also be explained in the framework of Correspondence Theory (McCarthy and Prince 1995), the current version of Optimality Theory, if we incorporate the concept of variable dominance (cf. Kiparsky 1993) to the theory. The constraints listed in (7) will be required. Refer to McCarthy and Prince 1995 for MAX family constraints. Seoul Korean has such pairs as *ui* 'the ear of a cow' vs. *wi* 'top' and *kiun* 'power' vs. *kyun* 'germ' that distinguish vowel and glides underlyingly. Accordingly, following Hayes (1989) and Y. S. Lee (1993) I assume that glides and vowels are underlyingly different in this language.

(7) Constraints required

1. OCP [lab] : The C[lab] C[V-pl, lab] sequence is prohibited.

2. MAX(C) : Every consonant in underlying representation has a correspondent in surface representation.

3. MAX(G): Every glide in underlying representation has a correspondent in the surface representation.

The ranking in (8) of the above three constraints in Seoul Korean accounts for the high deletion rate of *w* after a bilabial consonant in Seoul Korean, as shown in Table 9.

(8) Max(C) >> OCP[lab] > MAX(G)

N.B. '>>' and '>' indicate hard dominance (categorical dominance) and soft dominance (noncategorical dominance), respectively.

Table 9. *w* deletion after a bilabial consonant in Seoul Korean

/pweta/	MAX(C)	OCP[lab]	MAX(G)
a. pweta		*!	
b. ☞ peta			*
c. weta	*!		

N.B. The thick and double lines indicate hard and soft dominance, respectively.

6.2. Phonetic explanations

The loss of *w* after bilabial consonants found in many lexical items of Seoul Korean can be considered as a case where the OCP plays the role of a "diachronic rule trigger" (Yip 1988:86). There have been suggestions (e.g., Kenstowicz 1994, Zubritskaya and Sheffer 1995) that the OCP, a phonological configurational constraint, may have a phonetic, perceptual basis. I will show in this section that the loss of *w* after bilabial consonants observed in Seoul Korean is one case which supports these suggestions. I will argue that perceptual factors play an important role in this linguistic change.

The acoustic cue of *w* or any labial consonant is mainly the lowering of the second and third formants of the adjacent vowel (cf. Lieberman et al. 1956, Kent and Read 1992). When a nonlabial consonant precedes *w*, this acoustic cue of *w* remains intact. However, when a labial consonant like *b, p, m* precedes *w*, the acoustic cue of *w* becomes blurred and attenuated, since the preceding labial consonant provides essentially the same acoustic cue.

As a result, listeners have to distinguish the 'bilabial consonant + *w* + V' sequence and the 'bilabial consonant + V' sequence without the cue of formant transition. That is, they have to distinguish the two exclusively on the basis of a timing (or duration) difference (and a minor difference in the patterns of the stop burst, if the preceding consonant is an oral stop).[13] However, all the main cues are available for listeners' distinction of the 'nonlabial consonant + *w* + V' sequence and its *w*-less counterpart. This is shown in Figure 5 on the following page.

The acoustic ambiguity between the 'bilabial consonant + *w* + V' sequence and the 'bilabial consonant + V' sequence introduces confusion in the perception of listeners, and consequently leads them to attribute the acoustic cue of *w* to the preceding bilabial consonant. That is, listeners reinterpret the 'bilabial consonant + *w* + V' sequence as 'bilabial consonant + V'. This reinterpretation process results in new underlying forms of lexical items, as exemplified in Figure 4. I suggest that diachronic changes that happened to the words with the 'bilabial consonant + *w*' sequence in Seoul Korean, an OCP-triggered change in Yip's (1988) terms, are perceptually-motivated and can be explained as one of those cases which Ohala (1981:187) calls "sound change by the listener".

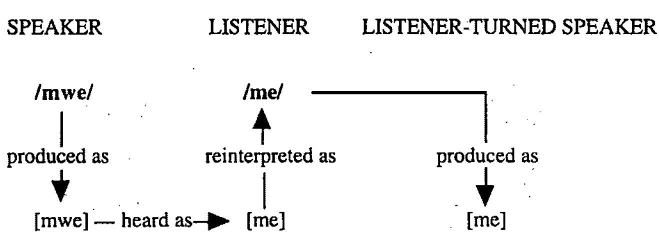

Figure 4. Sound change by the listener: from /mwe/ to /me/ 'mountain'

[13] *w* occurring after a bilabial stop has the effect of lowering the frequency position of the stop burst and making its spectral patterns more compact (Blumstein 1986).

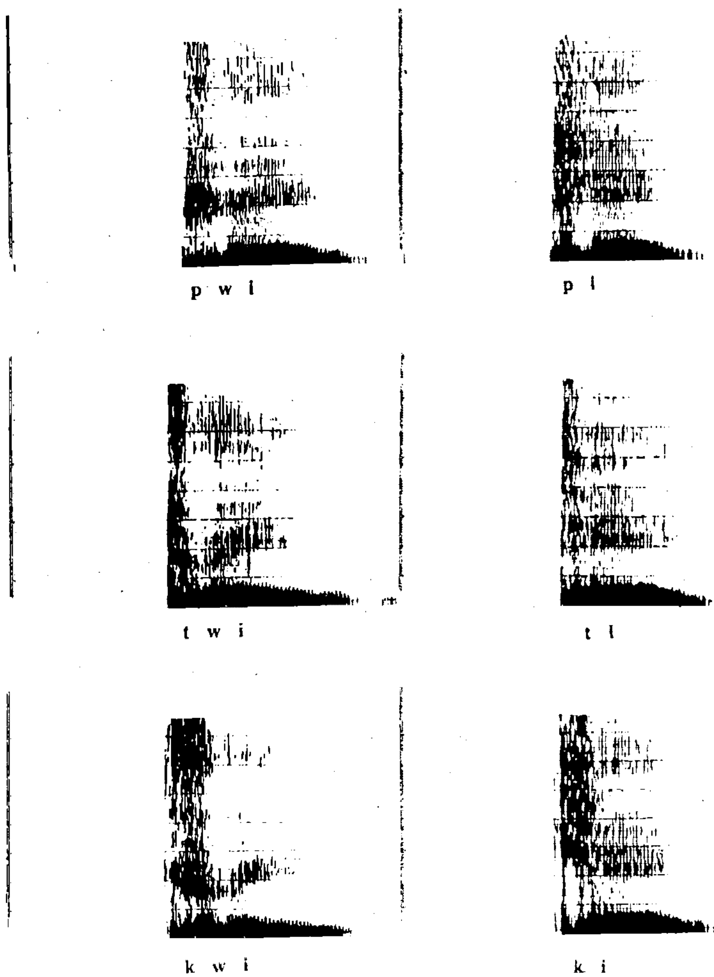

Figure 5. Spectrograms for [pwi] vs. [pi], [twi] vs. [ti], [kwi] vs. [ki]

7. Concluding remarks

The present study has examined the deletion of *w* in Seoul Korean on the basis of a large sociolinguistic database. The results of the statistical analyses of the data reveal that the deletion of *w* in Seoul Korean occurs more often in some phonological contexts than in others. Most notably it was found that *w* deletes significantly more often after labial segments. Crucially using the notion of the OCP, I have attempted to explain this pattern of variation phonologically in the framework of Correspondence Theory incorporating the notion of variable dominance. I claimed that *w* deletion in Seoul Korean is one case which shows that the OCP can trigger not only a categorical process but also a variable process. I also suggested that the loss of *w* after a bilabial consonant observed in many lexical items of Korean is an example where the OCP plays the role of the "diachronic rule trigger" (Yip 1988). I argued that this OCP-triggered change can also be explained in perceptual terms along the lines of Ohala (1981): similar acoustic cues of bilabial consonants and *w* cause listeners' misinterpretation of speakers' productions, which has introduced new *w*-less underlying forms into Seoul Korean.

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Appendix I.

1. Probabilities for factors for *w* deletion after a consonant in spontaneous speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.951	85	289
	alveolar	0.438	34	873
	palatal	0.335	20	135
	velar	0.366	22	661
	glottal	0.359	17	313
*Prec. C (manner)	lax	0.501	37	1194
	aspirated	0.433	26	117
	reinforced	0.537	31	192
*Following vowel	[-bk]	0.575	33	1134
	[+bk]	0.425	35	1137
*Syllable type	initial	0.462	37	1413
	noninitial	0.562	28	858
Morph. boundary	zero	0.489	39	1899
	present	0.556	27	358
*Presence of coda	zero	0.563	39	1273
	present	0.420	27	998
Speech Style	in-group	0.527	39	850
	interview	0.484	30	1421

*Gender	male	0.466	30	1194
	female	0.538	38	1077
*Social Status	upper	0.435	29	765
	middle	0.518	33	754
	lower	0.548	38	752
Age	16-25	0.520	39	783
	26-45	0.509	33	767
	46+	0.469	29	721

number of cells: 861 total chi-square = 1053.6709
chi-square/cell = 1.2238 loglikelihood = – 1184.070 Input = 0.353

2. Probabilities for factors for *w* deletion after a consonant in sentence reading speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.962	80	321
	alveolar	0.476	17	629
	palatal	0.249	08	413
	velar	0.340	13	584
	glottal	0.385	10	283
*Prec. C (manner)	lax	0.511	25	957
	aspirated	0.488	10	216
	reinforced	0.477	17	328
Following vowel	[-bk]	0.522	18	1047
	[+bk]	0.480	26	1183
*Syllable type	initial	0.394	18	1249
	noninitial	0.634	28	981
Morph. boundary	zero	0.503	20	1047
	present	0.449	52	1183
Presence of coda	zero	0.488	20	1513
	present	0.525	26	717
Gender	male	0.475	21	1113
	female	0.525	23	1117
*Social Status	upper	0.391	17	749
	middle	0.491	21	749
	lower	0.620	28	732
*Age	16-25	0.567	25	746
	26-45	0.545	24	747
	46+	0.387	17	737

number of cells: 941 total chi-square = 1017.2677
chi-square/cell = 1.0811 loglikelihood = – 812.533 Input = 0.186

3. Probabilities for factors for *w* deletion after a consonant in word-list reading speech

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.953	77	276
	alveolar	0.346	10	358
	palatal	0.369	12	288
	velar	0.418	12	529
	glottal	0.287	10	298
Prec. C (manner)	lax	0.489	24	567
	aspirated	0.534	12	267
	reinforced	0.490	13	290
Following vowel	[-bk]	0.475	14	1059
	[+bk]	0.535	32	690
*Syllable type	initial	0.368	14	1005
	noninitial	0.696	32	
Morph. boundary	zero	0.511	19	1632
	present	0.338	58	102
Presence of coda	zero	0.493	19	1263
	present	0.519	28	486
Gender	male	0.500	21	881
	female	0.500	22	868
*Social Status	upper	0.387	17	589
	middle	0.469	20	584
	lower	0.645	28	576
*Age	16-25	0.574	25	582
	26-45	0.543	23	585
	46+	0.384	17	582

number of cells: 783 total chi-square = 816.7801
chi-square/cell = 1.0431 loglikelihood = – 593.887 Input = 0.128

Appendix II.

Probabilities for factors for *w* deletion after a consonant in word-list reading speech (N.B. only the tokens where *w* occurs in the initial syllable of the word were subject to the analysis.)

Factor groups	Factors	Weight	% Applications	Total N
*Prec. C (place)	bilabial	0.983	73	120
	alveolar	0.281	03	204
	palatal	0.499	07	140
	velar	0.432	05	337
	glottal	0.267	03	204

Prec. C (manner)	lax	0.569	17	308
	aspirated	0.391	04	157
	reinforced	0.441	04	142
Following vowel	[-bk]	0.483	07	650
	[+bk]	0.531	23	355
Presence of coda	zero	0.431	12	667
	present	0.535	15	338
Phonemic V length	long	.466	11	562
	short	.543	14	443
Gender	male	0.465	12	510
	female	0.536	13	495
*Social Status	upper	0.292	08	338
	middle	0.441	10	332
	lower	0.756	20	335
*Age	16-25	0.684	17	332
	26-45	0.533	14	339
	46+	0.289	07	334

number of cells: 505 total chi-square = 478.6529
chi-square/cell = 0.9478 loglikelihood = – 197 137 Input = 0.042

REFERENCES

BLUMSTEIN, S. E. 1986. On acoustic invariance in speech. Invariance and variability in speech processes, ed. by J. Perkell and D. H. Klatt, 178-197. Hillsdale, New Jersey: Lawrence Erlbaum and Associates.

CHEN, M. 1973. Cross-dialectal comparison: A case study and some theoretical considerations. Journal of Chinese Linguistics, 1. 38-63.

CHOI, T. Y. 1983. Phonology of Korean dialects. Seoul: Hyongseol Publishing Co.

CLEMENTS, G. N., and S. J. KEYSER. 1983. CV phonology: A generative theory of the syllable. Cambridge, Massachusetts: MIT press.

CUTLER, A., J. A. HAWKINS and G. GILLIGAN. 1985. The suffixing preference: A processing explanation. Linguistics 23. 72358.

EOM, T. S. 1993. A study on underlying representation and phonological rules in Korean. Ph. D. dissertation. Sogang University. Seoul.

FRY, F. D. 1955. Duration and intensity as physical correlates of linguistic stress. Journal of the Acoustical Society of America 27. 765-8.

HALL, C. J. 1992. Morphology and mind: A unified approach to explanation in linguistics. New York: Routledge.

HAYES, B. 1989. Compensatory lengthening in moraic phonology. Linguistic Inquiry 20. 253-309.

HAYS, W. L. 1988. Statistics. Philadelphia, Pennsylvania: Holt, Rinehart and Winston, Inc.

HONG, Y. S. 1988. A sociolinguistic study of Seoul Korean. Hanshin Pub. Co.

HUME, E. 1995. (Non)Preservation in Leti. Talk given at University of Massachusetts. Amherst, Massachusetts.

HYMAN, L. 1975. Phonology: Theory and analysis. New York: Holt, Rinehart and Winston.

JUN, S. A. 1995. A phonetic study of stress in Korean. Paper presented at the 1995 ASA meeting. Saint Louis, Missouri.

KENSTOWICZ, M. 1994. Phonology in generative grammar. Cambridge, Massachusetts: Blackwell.

KENT, R. D. and C. READ. 1992. The acoustic analysis of speech. San Diego, California: Singular Publishing Group, Inc.

KIM, C. A. 1978. A study of diphthongs in Modern Korean. Kukeokupmunhak 15. 219-231. Department of Korean Language and Literature. Pusan University.

KIM, H. Y. 1990. Voicing and tensification in Korean: A multi-face approach. Hanshin Pub. Co.

KIM-RENAUD, Y. K. 1974. Korean consonantal phonology. Ph.D. dissertation. University of Hawaii.

KIPARSKY, P. 1993. Variable rules. Paper presented at Rutgers Optimality Workshop-1, October 22, 1993.

KLATT, D. H. 1973. Interaction between two factors that influence vowel duration. Journal of the Acoustical Society of America 54. 1102-4.

LABOV, W. 1972. The isolation of contextual styles. Sociolinguistic patterns. Philadelphia, Pennsylvania: University of Pennsylvania Press.

LEE, C. S. 1994. Korean phonology. Inchon: Inha University Press.

LEE, H. B. 1971. Vowel system of Seoul Korean. Language Research 7.2. 19-24.

LEE, H. B. 1973. A phonetic study of the accent in Korean. Mullidaehakpo 19. 1-16. Seoul University.

LEE, H. S. 1993. Kukeo Taesacheon (The Grand Dictionary of Korean). Seoul: Minchungseorim.

LEE, H. Y. 1990. A study of Korean prosody. Seoul: Hanshin Publishing Co.

LEE, P. K. and K. R. PARK. 1992. On the Kyongki dialect. A study of Southern and Northern Korean dialects, ed. by Y. P. Kim, 15-40. Seoul: Kyongun Publishing Co.

LEE, Y. S. 1993. Topics in the vowel phonology of Korean. Seoul: Hanshin Publishing Co.

LIEBERMAN, A. M., P. C. DELATTRE, L. J. GERSTMAN and F. S. COOPER. 1956. Tempo of frequency change as a cue for distinguishing classes of speech sounds. Journal of Experimental psychology 52. 127-137.

MACAULAY, R. K. S. and G. TREVELYAN. 1973. Language, education and employment in Glasgow. A Report to the Social Science Research Council.

MAGEN, H. S. and S. E. BLUMSTEIN. 1993. Effects of speaking rate on the vowel length distinction in Korean. Journal of Phonetics 21, 387-409.

MARAN, L. 1971. Burmese and Jinghpo: A study of tonal linguistics processes. Occasional Papers of the Wolfenden Society on Tibeto-Burman Linguistics, vol. 4. ed. by F. K. Lehman, Urbana. University of Illinois.

MARLETT, S. and J. STEMBERGER. 1983. Empty consonants in Seri. Linguistic Inquiry 13. 435-82.

MARTIN, S. 1992. A reference grammar of Korean: A complete guide to the grammar and history of the Korean language. Rutland, Vermont: Charles E. Tuttle Company.

MCCARTHY, J. 1981. A prosodic theory of nonconcatenative morphology. Linguistic Inquiry 12. 373-418.

MCCARTHY, J. 1986. OCP effects: Gemination and antigemination. Linguistic Inquiry 17. 207-264.

MCCARTHY, J. and A. S. PRINCE. 1995. Faithfulness and reduplicative identity. University of Massachusetts Occasional Papers 18. 249-394.

NAM, K. W. 1984. A study of Korean pronunciation. Seoul: Ilcokak.

OHALA, J. 1981. The listener as a source of sound change. CLS 18. 178-203.

POPHAM, J. P. and K. A. SIROTNIK. 1992. Understanding statistics in education. Itasca, Illinois: F. E. Peacock Publishers, Inc.

PARK, K. R. 1992. Perception study II of modern Korean vowels '*oy*, *ui*'. vol. 9. Kaysineomunyeonkuhoi.

PRINCE, A. and P. SMOLENSKY. 1993. Optimality theory: Constraint interaction in generative grammar. Rutgers University, New Brunswick, and University of Colorado, Boulder. RUCCS-TR-2.

RAND, D. and D. SANKOFF. 1992. GoldVarb: A variable rule application for the Macintosh, version 2.1. Montreal. Université de Montréal, Centre de recherches mathématiques.

ROSENTHALL, S. 1994. Vowel/glide alternation in a theory of constraint interaction. Ph.D. dissertation, University of Massachusetts, Amherst.

SILVA, D. J. 1991. Phonological variation in Korean: The case of the "disappearing *w*". Language Variation and Change 3. 153-170.

SOHN, H. S. 1987. Underspecification in Korean phonology. Ph.D. dissertation, University of Illinois, Urbana-Champaign.

YIP, M. 1988. The obligatory contour principle and phonological rules: A loss of identity. Linguistic Inquiry 19. 65-100.

ZUBRITSKAYA K. and H. SHEFFER. 1995. Gradience and the OCP in Optimality Theory. Paper presented at NWAV 24.